Cathelco Ballast Water Treatment System

Alternate Management System Review Checklist

A Guideline (G8) Specification (G8 Section noted in brackets)	B Cross Reference Applicant to identify page, paragraph and/or table where this information is located)	C Adequacy (USCG to note Y/N/NA)	D Comments (Applicant – black; USCG – red)
1. **BWMS Description [5]**			
1.1. BWMS description, including diagrammatic drawing(s) showing typical pumping and piping arrangements (including a Bill of Materials and the specifications and standard(s) which it meets), sampling facilities for control and monitoring systems, operational outlets for treated water and waste streams [5.1]			See Supplemental Comments Sheet
<u>BWMS Description</u>	Part 1 Technical Description ► Section 1.1 Equipment Technical Description ►Subsection 1.1.2 The Cathelco BWMS, pages 4-8		
<u>Drawings</u>	Part 3- Drawings and CFD ► Section 3.1 Typical P&ID ►Section 3.2 Typical equipment footprint ►Section 3.3 Typical weight and COG details ►Section 3.4 General arrangements drawings ►Section 3.5 Detailed drawings ► Section 3.6 Equipment sectional drawings ►Section 3.7 Interface and connection drawings ►Section 3.8 Electrical schematics		
<u>Sampling facilities for control and monitoring systems</u>	Part 1 Technical Description ► Section 1.1 Equipment Technical Description ► Subsection 1.1.4 Overview of System Components ► 1.1.6.6 Temperature Sensor, page 33 ► 1.1.6.9 Flow Meter, page 60 ► 1.1.6.10 UVT Meter, page 61 ► 1.1.6.11 Water Level Sensor, page 62 ► 1.1.6.12 UV Intensity Meter, page 63 ► 1.1.6.13 Pressure Sensor, page 64 ► 1.1.6.14 Electric actuated relay valves, page 65 ► 1.1.6.15 Electric actuated 4-20mA valves, page 67 Part 2 Operation Manuals ►Section 2.11 Manual of Filter RFCA ►Subsection 6.1.1 Sensors and Actuators, page 44		

Enclosure (2)

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Operational outlets for treated water and waste	Treated water discharge: Part 2 Operations Manuals ►Section 2.2 Normal operational procedures ►Subsection 2.2.1 System overview, pages 4-5 ► Section 3.7 Interface and connections drawings ► Subsection 3.7.5 .Interfaces pump room pipe work, pages 21-22 Filter back flush : Part 1 Technical description ► Section 1.1 Equipment technical description ► Subsection 1.1.6.1 RFCA filter, pages 12-15 and ► Subsection 1.1.6.2 ACB filter, pages 16-19 Part 3 Drawings and CFD ► Section 3.7 Interface and connections drawings ► Subsection 3.7.6 Mechanical Interfaces filter overboard discharge pipe, pages 23-24 Optional Tank stripping: Part 1 Technical description ► Section 1.1 Equipment technical description ► Subsection 1.1.7 Optional: Tank stripping		
1.1.1. Control equipment automatically monitors and adjusts necessary treatment dosages, intensities or other aspects of the BWMS necessary for proper administration of necessary treatment [4.10]	Part 1 Technical Description ► Section 1.1 Equipment Technical Description, pages 6 -7, ► Subsection 1.1.6.3. UV-reactor and manifold arrangement, pages 20– 27. ► Subsection 1.1.6.9 Flow meter, page 60 ► Subsection 1.1.6.10 UVT Meter, page 61 ► Subsection 1.1.6.12 UV Intensity Meter, page 63		
1.1.2. Control equipment incorporates a continuous self-monitoring function when BWMS is in operation [4.11]	Part 2 Operations Manuals ► Section 2.1 Pre Start Up Procedure ► Section 2.2 Normal Operational Procedures ► Section 2.4 Alarm and Shutdown Procedures Part 1 Technical Description ►Section 1.1 Equipment technical description including optional Tank Stripping ►Subsection 1.1.6 Overview of System Components ►Paragraph 1.1.6.7 Automatic Control Unit, pages 34-58 ► Annex 1 Monitoring System Logic ► Annex 2 Monitoring System HMI		

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1.1.3. Monitoring equipment records the proper functioning or failure of the BWMS. [4.12]	<u>Monitoring of functions:</u> Part 1 Technical Description ► Annex 2 Monitoring System HMI Part 2 Operations Manuals ► Section 2.2 Normal Operational Procedures ►Subsection 2.2.8 Downloading Log readings, page 105 ►Subsection 2.2.9 Summary Log-files, page 118 <u>Failure procedures:</u> Part 2 Operations Manuals ► Section 2.4 Alarm and Shutdown Procedures ► Section 2.5 Emergency Procedure		
1.1.4. Control equipment stores data on monitored functions and conditions for at least 24 months; stored data can be displayed or printed for inspection. [4.13]	Part 1 Technical Description ► Annex 2 Monitoring System HMI ► Subsection 2.1 Automation control unit, pages 4-6 ► Subsection 2.6 Passwords ► Subsection 2.8 Downloading Log readings ► Subsection 2.9 Summary Log-files		See Supplemental Comments Sheet
1.2. Protection against interference [4.5]	Part 4 Type Approval testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 6a UV lamps environmental testing report ► Annex 7 Report on environmental testing – Test report Cabinet –FSU 202-GCU ► Annex 8 RFCA Filter Control environmental testing report		
1.2.1. Every access beyond requirements of 4.4 requires breaking a seal [4.5.1]	Part 1 Technical Description ►Annex 2 Monitoring System HMI ►Subsection 2.6 Passwords		A Level 3 password is required to make any configuration changes to the BWMS. Level 3 passwords are “Administrative Level”.

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1.2.2. Visual alarm is activated whenever the BWMS is in operation for purpose of cleaning, calibration, or repair; such events recorded by control equipment. [4.5.2]	<u>Cleaning</u> Part 1 Technical Description ►Annex 1 Monitoring System Logic, page 4 Part 2 Operations Manuals ►Section 2.4 Alarm and Shutdown Procedures ►Subsection 2.4.7 Component Alarms ►Paragraph 2.4.7.6 CIP Alarms; and ►Paragraph 2.4.8.5 CIP Cleaning Mode <u>Calibration</u> All sensors are calibrated at the factory. No calibration is conducted onboard the ship. <u>Repair</u> Part 2 Operations Manuals ►Section 2.4 Alarm and Shutdown Procedures ►Subsection 2.4.7 Component Alarms ►Paragraph 2.4.7.3 UV Ballast Units		See Supplemental Comments Sheet
1.2.3. Suitable emergency over-rides/bypasses to protect ship and crew. [4.5.3]	Part 1 Technical Description ►Section 1.7 Impact of BWMS on Crew and Vessel Part 2 Operations Manuals ►Section 2.3 Ballast Water Management, page 8+9 ►Section 2.4 Alarm and Shutdown Procedure ►Section 2.5 Emergency Procedure		
1.2.4. By-passes activate an alarm and the event is recorded by the control equipment. [4.5.4]	Part 1 Technical Description ►Annex 1 Monitoring System Logic ►Subsection A 1.2.8 Alarm conditions checking during running modes Part 2 Operations Manuals ►Section 2.5 Emergency Procedure ► Subsection 2.5.1 Power Outage to the BWMS System ► Subsection 2.5.2 Power Outage of Automation Control Unit ► Subsection 2.5.3 Loss of Flow ► Subsection 2.5.4 Fire or need to immediate shutdown ► Subsection 2.5.5 Pipe Burst		

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1.3. Audible and visual alarm signals in stations from which ballast water operations and ballast water management are controlled. [4.3]	Part 1 Technical Description ►Section 1.4 Control Philosophy ►Section 1.4.1 System Integration, page 4 Part 2 Operations Manuals ► Section 2.4 Alarms and Shutdown Procedures ► Subsection 2.4.5. Alarm warning, page 8 ► Subsection 2.4.6. Alarm screen, page 9		
1.4. Manufacturer's equipment manuals containing details of major components of the BWMS and their operation and maintenance. [5.1.2]	Part 1 Technical description ►Section 1.1 Equipment technical description ►Section 1.2 Equipment datasheets Part 2 Operations manuals ► Section 2.2 Normal Operational Procedures ► Section 2.6 Preventive Maintenance ► Section 2.7 Planned maintenance routines ► Section 2.8 Major Maintenance ► Section 2.9 Maintenance record instructions ► Section 2.11 Manual of Filter RFCA ► Section 2.12 Manual of Filter ACB ► Section 2.13 Manual of UV components ► Section 2.14 Manual of UVT sensor ► Section 2.15 Manual of CIP system		
1.5. Operation and technical manual for complete BWMS covering arrangements, operation, and maintenance of the BWMS as a whole, and specifically describing any parts not covered by manufacturer's equipment manuals. [5.1.3]	See 1.4. above plus the following documents: Part 1 Technical description ►Section 1.3 Components not covered by Equipment datasheets		
1.5.1. Operations section of the manual includes normal operational procedures. [5.1.4]	Part 2 Operations Manuals ► Section 2.2 Normal Operational Procedures		
1.5.2. Documentation of simple and effective means for operation and control. [4.8]	Part 1 Technical description ►Section 1.1 Equipment technical description ►Subsection 1.1.6.7 Automation control unit, page 34 ►Annex 2 Monitoring System HMI Part 2 Operations Manuals ► Section 2.2 Normal Operational Procedures ► Subsection 2.2.5 Overview of the control system, page 8ff ► Subsection 2.2.6 Local control operation, page 11-76 ► Subsection 2.2.7 Remote control operation, page 77-104		
1.5.3. Operations manual includes procedures in the event of a malfunction of the BWMS, including emergency actions necessary for securing the ship. [5.1.4]	Part 2 Operations Manuals ►Section 2.3 Ballast Water Management ►Section 2.4 Alarm and Shutdown Procedure ►Section 2.5 Emergency Procedure		

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1.5.4. Operations manual contains maintenance procedures. [5.1.3]	Part 2 Operations manuals ► Section 2.6 Preventive Maintenance ► Section 2.7 Planned maintenance routines ► Section 2.8 Major Maintenance ► Section 2.9 Maintenance record instructions		
1.6. All working parts of the BWMS liable to wear or damage easily accessible for maintenance. [4.4]	Part 3 Drawings and CFD ► Section 3.2 Typical Equipment Footprint		
1.6.1. Means provided to check on drift of, repeatability by, measuring devices that are part of control equipment and for re-zeroing control equipment meters. [4.14]	Part 1 Technical description ► Section 1.2 Equipment data sheets ► Subsection 1.2.10 Flow meter manual, page 22 ► Subsection 1.2.12 Water level sensor, page 44 ►Annex 3 Installation Checklist ►Annex 4 Test Equipment Calibration Details ►Annex 5 Functional Test Procedures Part 2 Operations manuals ► Section 2.13 Manual of UV components ► Section 2.14 Manual of UVT sensor		All sensors and measuring devices are calibrated at the factory and require no re-calibration or servicing by shipboard personnel.
1.6.2. Facilities incorporated for checking the performance/calibration of components of BWMS that take measurements. [4.6]	Part 1 Technical description ►Annex 1 Monitoring System Logic		The first page of each section of the document describes the monitoring and follow-up operations for each of the operating modes.
1.7. Operations manual describes methods for conditioning of treated water prior to discharge to control residual treatment chemicals, disinfection by products, and the general suitability of the treated water for discharge. [5.1.5]	Not applicable		
1.8. Technical section of the manual includes adequate information (including description and diagrammatic drawings of monitoring and electrical/electronic wiring) to enable fault finding. [5.1.7]	Part 2 Operations manuals ► Section 2.10 Recommended Electrical Fault-Finding Procedure		
1.9. Technical section of the manual includes specifications defining, inter alia, requirements for location and mounting of components, arrangements for sampling by control and monitoring equipment, and arrangements for ensuring safe operation. [5.1.8]	Part 1 Technical description ► Section 1.6 Hazardous Area Considerations ► Annex 6 On Board Survey Procedures Part 2 Operations manuals ► Section 2.16 Site Receiving / Handling instructions ► Section 2.18 Utility Requirements ► Section 2.19 Erection and installation ► Section 2.20 Pre-Commissioning Preparation and Cleaning		

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1.9.1. BWMS components, if intended for fitting in locations where flammable atmospheres may be present, comply with relevant safety regulations, certified by Administration as safe for use in a hazardous area. [4.9]	Part 1 Technical description ► Section 1.6 Hazardous Area Considerations		
1.10. Operations and technical manual contains a recommended test and checkout procedure, specifying all the checks to be carried out in a functional test following installation and a test by a surveyor when carrying out an onboard survey to confirm the installation meets the manufacturer's specific installation criteria. [5.1.9]	Part 1 Technical description ► Annex 5 Functional Test Procedures ► Annex 6 On Board Survey Procedures		
1.11. BWMS is robust and suitable for working in the shipboard environment, with design, construction and materials, including electronic and electrical components, including a Bill of Materials and the specifications and standard(s) which it meet(s), adequate for intended service. [4.7.3]	Part 4 Type approval testing ► Annex 3 LR Plan Approval ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 6a UV lamps environmental testing report ► Annex 7 Report on environmental testing – Test report Cabinet –FSU 202-GCU ► Annex 8 RFCA Filter Control environmental testing report		See Supplemental Comments Sheet.
2. Type Approval Certificate			
2.1. Type approval certificate issued by, or on behalf of, the Administration. [6.1]	Part 5 Type Approval Certificate ► Type Approval Certificate-BSH_Cathelco ► Type Approval Certificate-BSH_Cathelco_Scale_Units		
2.1.1. Specification of any limiting conditions on the usage of the BWMS, including but not limited to ballast water volumes, flow rates, salinity, temperature, etc. [6.1 and 6.2]	Part 5 Type Approval Certificate ► Type Approval Certificate-BSH_Cathelco ► Type Approval Certificate-BSH_Cathelco_Scale_Units		
2.1.2. Specification of the type and model of the BWMS, including identification of duly dated equipment assembly drawings bearing model specification numbers or equivalent identification details. [6.5]	Part 5 Type Approval Certificate ► Type Approval Certificate-BSH_Cathelco ► Type Approval Certificate-BSH_Cathelco_Scale_Units		
3. Environmental and Public Health Impacts Assessment Documentation			
3.1. Protections reduce to minimum danger to persons (i.e., hot surfaces, moving parts, exposure to chemicals, UV, etc) [4.7]	Part 1 Technical description ► Section 1.7 Impact of BWMS on Crew and Vessel Part 2 Operations Manuals ► Section 2.6 Preventive Maintenance ► Subsection 2.6.1 Warnings, page 3 ► Section 2.7 Planned maintenance routines ► Subsection 2.7.1 Warnings, page 3 ► Section 2.8 Major Maintenance ► Subsection 2.8.1 Warnings, page 3		

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3.2. Complete application dossiers for IMO active substance basic and final approvals [Annex Part 1, 1.6.4]	Not applicable		
3.3. Adequate arrangements for storage, application, mitigation, and safe handling of any substances of a dangerous nature [4.2]	Not applicable		
4. Quality Assurance (QA) and Quality Control (QC) (AnnexPart 1, 2.1)			
4.1. Quality Management Plan (QMP) addressing the quality control management structure and policies of the testing body, including all subcontractors and outside laboratories) [Annex Part 2, 2.1.2.2]	Part 4 Type approval testing ► Annex 1c NIOZ QM plan ► Annex 2a MEA test protocol and QAPP page 11, 12 ►Annex 2c MEA ISO 9001 Cert. ►Annex 2b MEA Report on shipboard tests ►Subsection 5.1 Project Management, page 11		Subsection 5.1 references ISO 9001 Certification and QMP. Document. Lloyds Register issued ISO 9001 Certification as per Annex 2c
4.2. Quality Assurance Project Plan (QAPP) describing the specifics of the BWMS, the test facility, and other conditions affecting the design and implementation of the test procedures [Annex Part 2, 2.1.2.3]	Part 4 Type approval testing ► Annex 1b NIOZ QAPP ► Annex 2a MEA test protocol and QAPP		
4.3. Shipboard Test Plan and Report [Annex Part 2, 2.2.2.1]	Part 4 Type approval testing ► Annex 2a MEA test protocol and QAPP ► Annex 2b MEA Report on shipboard tests		
4.3.1. Documentation that treatment rated capacity of BWMS was appropriate for ship [Annex Part 2, 2.2.2.2]	Part 4 Type approval testing ► Section 4.5 Summary shipboard tests ► Annex 2b MEA Report on shipboard tests, page 4 Part 1 Technical Description ►Annex 9 Technical specifications of ballast pump installed on MV Eddystone, page 1		
4.3.2. Documentation that the volume and pumping rate of ballast water during test was consistent with normal ballast operations of ship [Annex Part 2, 2.2.2.3]	Part 4 Type approval testing ► Section 4.5 Summary shipboard tests, pages 5-9 ► Annex 2b MEA Report on Shipboard Tests ►Subsection 8 General Information on test runs, pages 21-22 Part 1 Technical Description ►Annex 9 Technical specifications of ballast pump installed on MV Eddystone, page 1		
4.3.3. Documentation of all test cycles, demonstrating three valid consecutive test cycles showing discharge of treated ballast water meeting regulation D-2 standard [Annex Part 2,2.2.2.4 and 2.2.2.9]	Part 4 Type approval testing ► Section 4.5 Summary shipboard tests ► Annex 2b MEA Report on shipboard tests ► Subsection 9 Biological results, pages 23-24		

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4.3.4. Tests meet minimum organism concentrations during uptake of more than 10 times the maximum permitted values in regulation D-2.1. [Annex Part 2, 2.2.2.5]	Part 4 Type approval testing ► Section 4.5 Summary shipboard tests ► Annex 2b MEA Report on shipboard tests ► Subsection 4 Results, pages 9-17		
4.3.5. Documentation that sampling regime was appropriate, either by meeting G8 recommendations for control and treated ballast water including: 1) Control tank replicates 2) Treatment tank replicates 3) Sample sizes; or 4) By documenting appropriate validation of sample volumes and numbers, per EPA ETV. [Annex Part 2, 2.2.2.6]	Part 4 Type approval testing ► Annex 2a MEA test protocol and QAPP ► Subsection 4.1. Sampling Methodology, pages 6-8		
4.3.6. Documentation that test cycles completed over at least six months. [Annex Part 2, 2.2.2.7]	Part 4 Type approval testing ► Annex 2b MEA Report on shipboard tests ► Section 1 Summary, page 4		
4.3.7. Documentation of source water characterization for salinity, temperature, POC, and TSS. [Annex Part 2, 2.2.2.9]	Part 4 Type approval testing ► Annex 2b MEA Report on shipboard tests ► Subsection: Annex 3 Abiotic parameters measured, pages 25-29		
4.3.8. Documentation of system operations, including: 1) Volume and locations of uptake & discharge volume;	Part 4 Type approval testing ► Section 4.5 Summary of shipboard tests, page 3		
2) Possible reasons for unsuccessful test cycle or failure of a cycle to meet D-2 Standard.	Part 4 Type approval testing ► Annex 2b MEA Report on shipboard tests, pages 7, 18		See Supplemental Comments Sheet.
3) Scheduled maintenance;	Part 2 Operations Manuals ► Section 2.6 Preventative Maintenance ► Section 2.7 Planned Maintenance Routines		All scheduled maintenance required by the Preventative Maintenance Schedule and Planned Maintenance Routines were completed by ship's crew.
4) Unscheduled maintenance and repair;	Not conducted		
5) Appropriate engineering parameters; and	Part 4 Type approval testing ► Section 4.5 Summary of shipboard tests (see Summary tables of individual shipboard tests)		
6) Proper functioning of control and monitoring equipment. [Annex Part 2, 2.2.2.10]	Part 4 Type approval testing ► Section 4.5 Summary of shipboard tests (see Summary tables of individual shipboard tests)		
4.4. Land-based Test Plan and Report [Annex Part 2, 2.4)	Part 4 Type approval testing ► Section 4.4 Summary of land-based tests ► Annex 1a NIOZ Project Plan ► Annex 1d NIOZ report on land-based tests		

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4.4.1. Description of test set-up, including:			
1) Arrangement of BWMS [Annex Part 2, 2.3.9]	Part 4 Type Approval testing ► Section 4.1 General system description, pages 8–9 ► Annex 1d NIOZ report on land-based tests, pages 20-22		
2) Piping and pumping arrangements [Annex Part 2, 2.3.9]	Part 4 Type Approval testing ► Annex 1d NIOZ report on land-based tests ► Subsection 2.3.1 Marine water: high and intermediate salinities, page 17 ► Subsection 2.3.2 Fresh water, page 17		
3) Tank specifications (treatment and control)[Annex Part 2, 2.3.12]	Part 4 Type Approval testing ► Annex 1d NIOZ report on land-based tests ► Subsection 2.3.1 Marine water: high and intermediate salinities, page 16 ► Subsection 2.3.2 Fresh water, page 17		
4) Facilities for representative sampling [Annex Part 2, 2.3.12]	Part 4 Type Approval testing ► Annex 1d NIOZ report on land-based tests ►Subsection 4.2 General sampling strategy, page 29		
5) Augmentation facilities for DOC, POC, TSS and standard test organisms if used [Annex Part 2, 2.3.12]; and	Part 4 Type Approval testing ► Annex 1d NIOZ report on land-based tests ►Subsection 4.3 Abiotic quality, page 29-31 ►Annex 1b NIOZ QAPP and test protocol ►Subsection 4.1 Abiotic quality, page 23-25		No standard organism augmentation was necessary. Concentration of organisms in ambient water was sufficient.
6) Monitoring facilities for environmental parameters including pH, temperature, salinity, dissolved oxygen, TSS, DOC, POC, and turbidity. [Annex Part 2, 2.3.12]	Part 4 Type Approval testing ► Annex 1d NIOZ report on land-based tests ►Subsection 4.3 Abiotic quality, page 30-31		
4.4.2. Documentation that system was operated at treatment rated capacity, or scaled as follows:	Part 4 Type Approval Testing ► Section 4.4 Summary of land-based tests		
1) 200 m3 / hr < TRC < 1,000 m3 / hr – downscaled no more than 1:5	Not applicable		
2) TRC>1,000 m3 – downscaled no more than 1:100	Not applicable		
3) Documentation of mathematical modeling and/or calculations demonstrating downscaling used would not affect functioning and effectiveness onboard ship at full scale for which certification is intended. [Annex Part 2, 2.3.13]	Part 3 Drawings and CFD ► Annexes 1-9		

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4.4.3. Description of cleaning procedures for test set-up before starting testing, and between test cycles. [Annex Part 2, 2.3.11]	Part 4 Type approval testing ►Annex 1d NIOZ report land-based tests ►Subsection 2.3.1 Marine water high and intermediate salinities, page 16		
4.4.4. Description of sampling and analysis procedures for organisms and environmental/water quality parameters, including:			
1) Identification of standard methods [Annex Part 2, 4.2] ;	Part 4 Type Approval Testing ► Annex 1b NIOZ QAPP and Test protocol ► Section 4 Test water: Quality, Sampling, Storing, pages 23-30		
2) Validation of non-standard methods. [Annex Part 2, 4.3] ;			All testing methods used by NIOZ have been validated through previous testing experiments.
3) Validation of appropriateness of sample processing times [Annex Part 2, 2.3.34]; and	Part 4 Type Approval Testing ► Annex 1b NIOZ QAPP and Test protocol ► Subsection 5 Measurement of variables, Table 4 page 32 reference to SOP		
4) Description and validation of facilities and procedures for collecting representative samples [Annex Part 2, 2.3.1; 2.3.17; 2.3.18; 2.3.19; 2.3.20; 2.3.36]	Part 4 Type Approval Testing ► Annex 1b NIOZ QAPP and Test protocol ► Subsection 4.5 Biological variables Sampling and storage, page 28-30		
4.4.5. Results of all analyses for organisms, challenge conditions, and BWMS performance indicators [Annex Part 2, 2.3.23; 2.3.24]	Part 4 Type Approval testing ►Section 4.4 Summary of land-based tests ► Annex 1d NIOZ report on land-based tests ► Section 5 G8 results and discussion, pages 37-50		
4.4.6. Documentation the BWMS was operated, and performed as designed within its specified parameters, including power consumption, flow rate, etc. [Annex Part 2, 2.3.4; 2.3.24]	Part 4 Type Approval testing ►Section 4.4 Summary of land-based tests		
4.4.7. Documentation of all test cycles, demonstrating 5 valid tests with treated water meeting the D-2 discharge standard for each salinity regime for which testing was conducted [Annex Part 2, 2.3.1; 2.3.17; 2.3.18; 2.3.19; 2.3.20; 2.3.36]	Part 4 Type Approval Testing ► Section 4.4 Summary of land-based tests ► Annex 1d NIOZ report on land-based tests ►Executive Summary, page 11 ► Section 5 G8 results and discussion, pages 37-50		
4.5. Environmental Testing [Annex Part 3]			

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4.5.1. Documentation of vibration tests [Annex Part 3, 3.4 – 3.7]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ►Subsection 5.1 Vibration tests, page 4 ► Annex 6a UV lamps environmental testing report ► Annex 7 Report on environmental testing – Test report Cabinet –FSU 202-GCU ► Annex 8 RFCA Filter Control environmental testing report		
4.5.2. Documentation of temperature tests [Annex Part 3, 3.8 – 3.10]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 7 Report on environmental testing – Test report Cabinet – FSU 202-GCU		
4.5.3. Documentation of humidity tests [Annex Part 3, 3.11]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 7 Report on environmental testing – Test report Cabinet – FSU 202-GCU		
4.5.4. Documentation of heavy seas protection tests [Annex Part 3, 3.12]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 6a Report on environmental testing – UV lamps ► Annex 7 Report on environmental testing – Test report Cabinet – FSU 202-GCU		
4.5.5. Documentation of power supply fluctuation tests {Annex Part 3, 3.13]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 7 Report on environmental testing – Test report Cabinet – FSU 202-GCU		
4.5.6. Documentation of inclination tests [Annex Part 3, 3.14]	Part 4 Type Approval Testing ► Annex 5 Report on the environmental testing of the BWTS switchboard and Automation Unit ► Annex 7 Report on environmental testing – Test report Cabinet – FSU 202-GCU		